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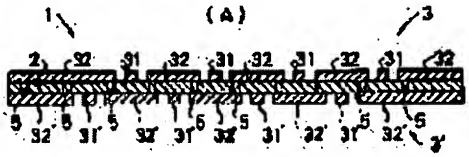
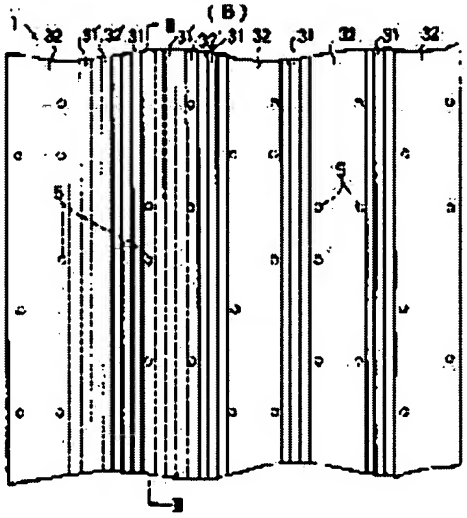
(54) FLEXIBLE PRINTED CIRCUIT BOARD IN DOUBLE-LAYER STRUCTURE

(57)Abstract:

PURPOSE: To provide a flexible printed circuit board in double-layer structure suited for a high-speed signal transmission.

CONSTITUTION: In a flexible printed circuit board 1 in double-layer structure, ground wire patterns 32 and 32' on the upper and lower surfaces of an insulating material strip 2 and each through hole 5 connecting the ground wire patterns form a plurality of small loops. Then, the smaller the loop is, the higher the resonance frequency becomes. Therefore, noise generation can be suppressed by setting the loop size, namely the position and the number of through holes in the longer direction of a pattern so that the resonance frequency becomes much higher than a signal frequency region, thus achieving a high-quality signal transmission in the signal frequency region.





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CLAIMS

[Claim(s)]
[Claim 1] In the two-layer structure flexible printed circuit board by which it comes by turns to arrange the grounding conductor pattern and signal-line pattern which are prolonged in the die-length direction of said insulating material strip on the top face and underside of an insulating material strip crosswise [of said insulating material strip] The crosswise edge in the grounding conductor pattern of said top face and the crosswise edge in the grounding conductor pattern of said underside The two-layer structure flexible printed circuit board characterized by forming the through hole which connects electrically the crosswise edges which have lapped mutually in plane view and lapped with said die-length direction mid-position in said insulating material strip in said plane view.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the two-layer structure flexible printed circuit board which comes to form a grounding conductor pattern and a signal-line pattern in the top face and underside of an insulating material strip in more detail about the flexible printed circuit board used for transmission of an electrical signal.
[Description of the Prior Art]
[0002] There are a thing of two-layer structure and a thing of the multilayer structure beyond it in a multilayer-structure flexible printed circuit board. The flexible printed circuit board of two-layer structure consists of an insulating material strip and two electric conduction patterned layers formed in the top face and underside of this insulating material strip. The signal-line pattern and grounding conductor pattern which are prolonged in the die-length direction of an insulating material strip are arranged by turns crosswise [of an insulating material strip], and each electric conduction patterned layer is formed. Moreover, for example, the flexible printed circuit board of a three-tiered structure consists of a strip with a ground layer made from the insulating material on both sides of the tabular ground layer of one sheet from the upper and lower sides, and two patterned layers formed in the top face and underside of this strip with a ground layer. Each electric conduction patterned layer is formed like the thing of the above-mentioned two-layer structure.
[0003] In the flexible printed circuit board of such multilayer structure, a grounding conductor pattern or a ground layer shields between ****** or the signal-line pattern which approaches each other up and down, and prevents the cross talk between these. For this reason, if these printed circuit boards are used, a high-definition signal transmission can be performed.
[0004]
[Problem(s) to be Solved by the Invention] However, in a two-layer structure flexible printed circuit board, since a loop formation is formed with the grounding conductor pattern of the upper and lower sides by which ground connection was carried out and the loop formation of a parenthesis will become big corresponding to the die length of a printed circuit board, there is a problem of being easy to resonate in a comparatively low frequency region. For this reason, it may resonate exactly in the signal frequency region for high-speed transmission, and a noise will keep close in a transmission signal in this case. Therefore, the two-layer structure flexible printed circuit board was unsuitable for high-speed transmission.
[0005] On the other hand, in a three-tiered structure flexible printed circuit board, since a ground layer does not form a loop formation and does not resonate, such a problem is not produced. For this reason, if a three-tiered structure flexible printed circuit board is used, a high-definition and high-speed signal transmission can be performed. However, the thing of a three-tiered structure has the problem that a manufacturing cost is higher than the thing of two-layer structure, or flexibility is missing.
[0006] This invention is made in view of such a problem, and aims at offering the two-layer structure flexible printed circuit board suitable for a high-speed signal transmission.

[0007]
[Means for Solving the Problem] In order to attain the above-mentioned object, in the two-layer structure flexible printed circuit board of this invention, the crosswise edge in the grounding conductor pattern of the top face of an insulating material strip and the crosswise edge in a grounding conductor pattern at the bottom have lapped mutually in plane view. And the through hole which connects electrically the crosswise edges which lapped with the die-length direction mid-position in an insulating material strip in the above-mentioned plane view is formed.
[0008]
[Function] In such a two-layer structure flexible printed circuit board, two or more small loop formations are formed of each through hole which connects the grounding conductor pattern and these grounding conductor pattern of a top face and an underside. And the part and resonance frequency to which the loop formation became small become high. For this reason, if the location and number of through holes in the magnitude of a loop formation, i.e., the die-length direction of a pattern, are set up so that resonance frequency may become sufficiently higher than a signal frequency region, generating of a noise will be suppressed and the high-definition signal transmission in the above-mentioned signal frequency region will become possible.
[0009]
[Example] It explains referring to a drawing about the desirable example of this invention hereafter. The two-layer structure flexible printed circuit board 1 concerning this invention is shown in drawing 1 . This printed circuit board 1 consists of an insulating material strip 2 formed in band-like from insulating materials, such as polyimide, and two patterned layers (the top patterned layer 3 and bottom patterned layer 3') formed in the top face and underside of this insulating material strip 2. In addition, the connector (the male form connector 11 and female form connector 12) is attached in the longitudinal direction ends in the top face of a printed circuit board 1, respectively.
[0010] As a top and the bottom patterned layer 3, and 3' are shown in drawing 2 (A), respectively, the signal-line pattern 31, 31', and the grounding conductor pattern 32 and 32' are constituted together with alternation crosswise [of the insulating material strip 2]. As each signal-line pattern 31, 31' and each grounding conductor pattern 32, and 32' are shown in drawing 1 and drawing 2 (A), straight stretch ******, the signal-line pattern 31, and 31' are arranged in the form inserted between two grounding conductor patterns at the longitudinal direction of the insulating material strip 2. Each grounding conductor pattern 32 and 32' are formed more broadly than each signal-line pattern 31 and 31', and each grounding conductor pattern 32 and the crosswise edges of 32' overlap mutually in plane view. In addition, the part which overlap in this plane view is hereafter called the duplication part of a grounding conductor pattern.
[0011] And as shown in drawing 2 (B), it is the part pinched by the above-mentioned duplication part in the insulating material strip 2, and many through holes 5 are formed especially in the die-length direction mid-position of this strip 2, without defining the die-length direction location (at random). For this reason, in the die-length direction, spacing between the ****** through hole 5 and 5 is various. As shown in drawing 3 in detail, each through hole 5 forms conductive layer 5b in the inner surface of through hole 5a which penetrates the insulating material strip 2 in the vertical direction (the thickness direction), is constituted, or through hole 5a is filled up with a conductive metal, and it is constituted. For this reason, the upper grounding conductor pattern 32 and lower grounding conductor pattern 32' are electrically connected through this through hole 5. In addition, all the grounding conductor patterns 32 and 32' are connected with one through each through hole 5 so that drawing 2 (A) may show.
[0012] Thus, a RF signal is inputted into the signal-line pattern 31 of the constituted two-layer structure flexible printed circuit board 1, and 31'. Moreover, or the grounding conductor pattern 32 and 32' adjoin each other on both sides of this grounding conductor pattern, they shield electrically the signal-line pattern 31 which approaches up and down mutually, and 31', and they prevent the cross talk between them.
[0013] In this two-layer structure flexible printed circuit board 1, as the chain line shows to drawing 3 , in the die-length direction of a printed circuit board 1, the loop formation shown by L1-L4 is formed all

over drawing of the through holes 5 and 5 of two ******, and the grounding conductor pattern 32 of the upper and lower sides divided by these and 32'. Since the die-length direction spacing between each through hole 5 differs as mentioned above, the magnitude of each loop formations L1-L4 differs, respectively. Although each loop formations L1-L4 resonate on the specific frequency corresponding to the magnitude, the resonance frequency is expressed with the following formulas.
[0014]
f= 1/(2piroot (LC)) -- (formula 1)
However, for resonance frequency and L, an inductance and C are [f] electrostatic capacity.
[0015] Here, the graph of drawing 4 (A) shows the isolation (leakage signal strength between contiguity signal lines) to each signal frequency in the printed circuit board 100 in which the through hole is not formed at all, as shown in this drawing (B). The magnitude (inductance L) of the loop formation in this case is the grounding conductor pattern 32 and the magnitude corresponding to the overall length of 32', and an isolation serves as Peak P around 200MHz so that the graph of (A) may show. Moreover, the graph of drawing 5 (A) shows the isolation in the printed circuit board 100 by which only one through hole 105 was formed in the center of the die-length direction, as shown in this drawing (B). In this case, the peak P of the part from which the magnitude of a loop formation became half [of what has a nothing through hole], and an isolation moves to nearly 300-400MHz higher than what has a nothing through hole (formula 1 reference).
[0016] Furthermore, the graph of drawing 6 (A) shows the isolation in the printed circuit board 100 which carried out two or more (drawing seven pieces) formation of the through hole 105 at equal intervals in the die-length direction pars intermedia, as shown in this drawing (B). In this case, the magnitude of a loop formation becomes quite small and the peak P of an isolation moves to the band near [still higher than the case where there is only one through hole] 800-1000MHz (formula 1 reference). For this reason, using this printed circuit board 100, even if it performs a signal transmission around 500MHz, there is no generating of a noise and it can perform a high-definition signal transmission. However, if two or more through holes 105 are formed at equal intervals in this way, since all the loop formations formed in this printed circuit board 100 will become the same magnitude, the problem that the peak value of the isolation in the resonance point will become large can be considered. For this reason, as shown in drawing 2 (B) and drawing 3 , it is desirable to make random spacing between the through holes 5 about a longitudinal direction. Since the strength of each peak P of what the peak P of an isolation will be distributed and will be produced by this is stopped, better electrical characteristics can be acquired.
[0017]
[Effect of the Invention] As explained above, in the two-layer structure flexible printed circuit board of this invention, two or more small loop formations can be formed with the through hole formed in the insulating material strip, and the grounding conductor pattern which prepared in the top face and underside of this insulating material strip, and was kicked. for this reason, if the location and number (getting it blocked -- the magnitude of each loop formation) of through holes are decided to become sufficiently higher than the frequency band of the signal which the resonance frequency of each loop formation should transmit, the high speed and high definition transmission of a signal can be performed using this two-layer structure flexible printed circuit board.

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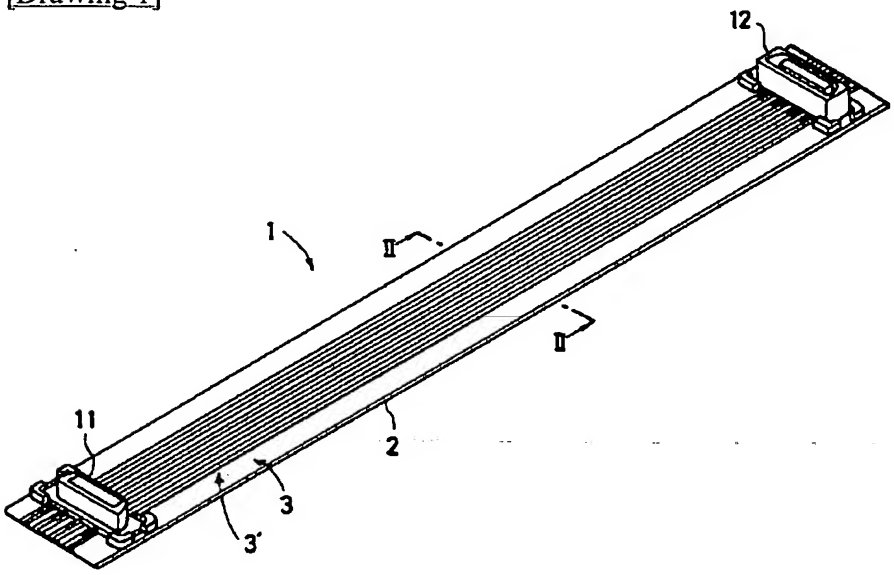
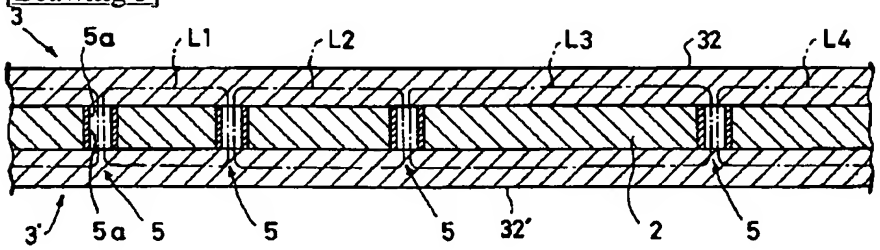
DRAWINGS

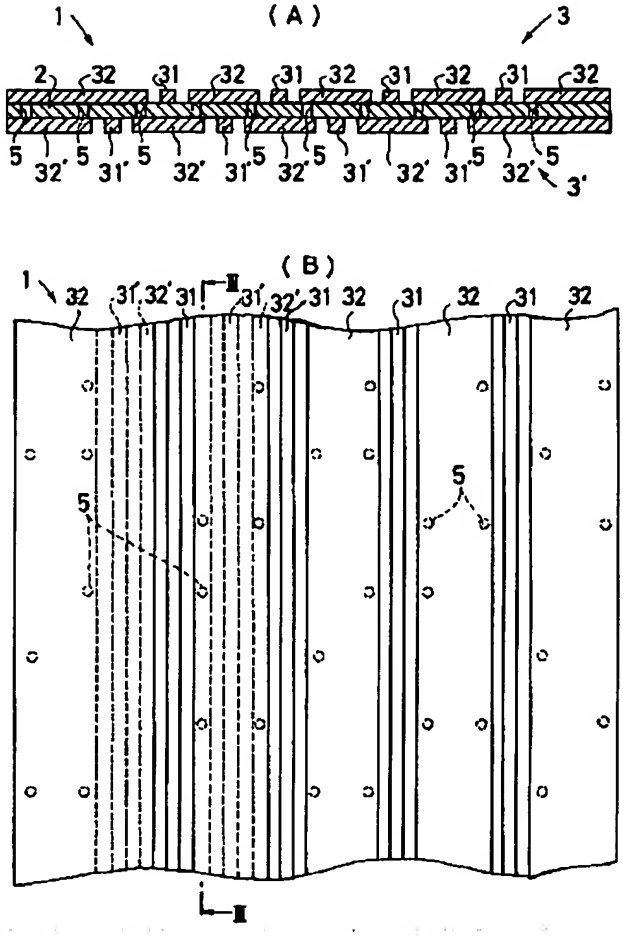
[Drawing 1]



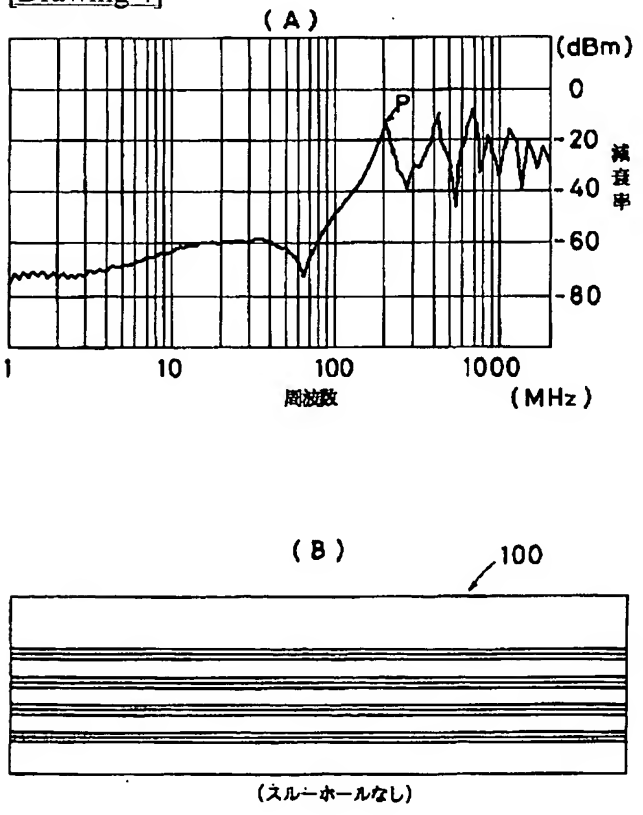
[Drawing 3]



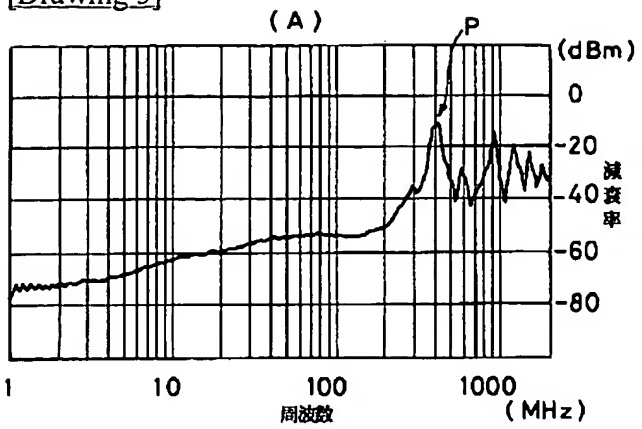
[Drawing 2]

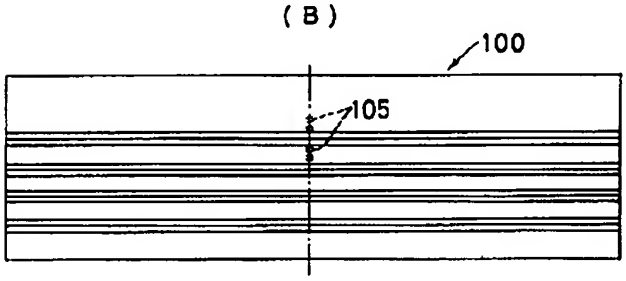

(A)
1
3
2
32
31
5
3'
(B)
I
II

[Drawing 4]

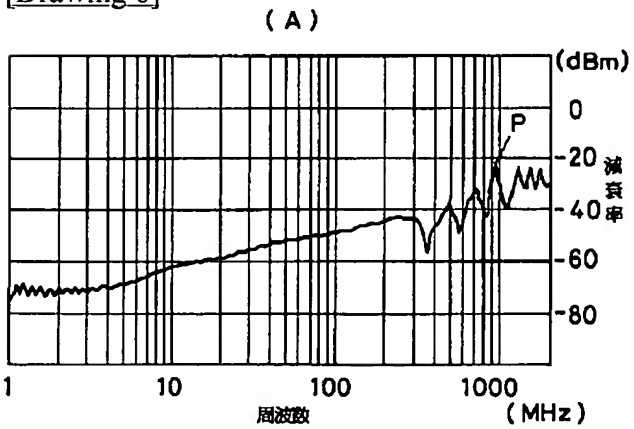

(A)
(dBm)
0
-20
-40
-60
-80
減衰率
P
1
10
100
1000
周波数
(MHz)
(B)
100
(スルーホールなし)

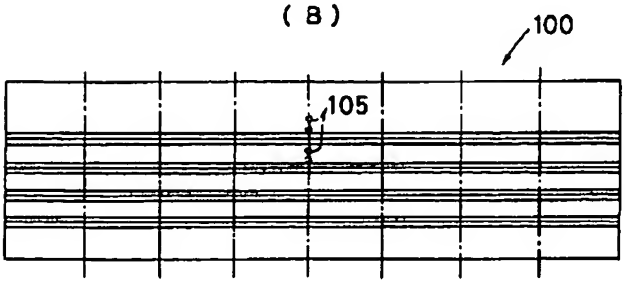
[Drawing 5]





[Drawing 6]





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